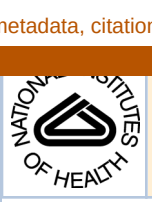

Published in final edited form as:

Epidemiol Infect. 2012 March ; 140(3): . doi:10.1017/S0950268811000513.

Costs of Illness Due to Endemic Cholera

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Summary

Economic analyses of cholera immunization programmes require estimates of the costs of cholera. The Diseases of the Most Impoverished programme measured the public, provider, and patient costs of culture-confirmed cholera in four study sites with endemic cholera using a combination of hospital- and community-based studies. Families with culture-proven cases were surveyed at home 7 and 14 days after confirmation of illness. Public costs were measured at local health facilities using a micro-costing methodology. Hospital-based studies found that the costs of severe cholera were USD 32 and 47 in Matlab and Beira. Community-based studies in North Jakarta and Kolkata found that cholera cases cost between USD 28 and USD 206, depending on hospitalization. Patient costs of illness as a percentage of average monthly income were 21% and 65% for hospitalized cases in Kolkata and North Jakarta, respectively. This burden on families is not captured by studies that adopt a provider perspective.

I. Introduction

Cholera remains a serious illness because of its rapid onset, severity, and the fact that cholera outbreaks can overwhelm public health systems. In 2006, 52 countries reported

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Declaration of Interest

This work was supported by the Diseases of the Most Impoverished Program, funded by the Bill and Melinda Gates Foundation and coordinated by the International Vaccine Institute.

236,896 cholera cases and 6,311 deaths to the WHO[1]. These numbers do not reflect the true burden of cholera due to limitations in the surveillance and notification systems of many countries and widespread underreporting [1]. Developing country policymakers need information on the burden of cholera in order to support rational decisions on control strategies, including the use of new generation cholera vaccines[2].

The Diseases of the Most Impoverished (DOMI) programme is assisting decision makers by translating country-specific data—on disease burden, cholera vaccine safety, efficacy and field effectiveness, vaccine cost-effectiveness, and private demand and willingness-to-pay for vaccines—into rational decisions regarding the use of new-generation cholera vaccines.

This paper describes studies that measured the costs of endemic cholera in study areas in North Jakarta, Indonesia, Kolkata, India, Matlab, Bangladesh, and Beira, Mozambique from both the provider and the patient perspective. The studies in Matlab, Bangladesh and Beira, Mozambique were hospital based, while the studies in North Jakarta, Indonesia and Kolkata, India combined both hospital-based and community-based data collection. These costs are being used to analyse the cost savings due to disease control strategies that reduce the number of cholera cases.

II. Methods

The patient and public cost studies were coordinated with prospective studies of disease burden. For every patient agreeing to participate, a case report form was completed and a stool culture was performed for *V. cholerae* O1 and O139. The study sites were mainly urban and all age groups were under surveillance in all sites except Beira, where surveillance excluded children under 2 years of age.

The hospital-based studies in Beira, Mozambique and Matlab, Bangladesh were conducted at the Cholera Treatment Center (CTC) and the Matlab International Center for Diarrheal Disease Research, Bangladesh (ICDDR,B) hospital, respectively. Both facilities specialize in the treatment of severe diarrhoea. The CTC is a public facility serving 22,000 residents of an impoverished urban neighborhood in Beira.The Matlab hospital is a 100-bed facility serving a population of 220,000 people covered by ICDDR,B's Health and Demographic surveillance system.

In the community-based studies in Kolkata, India [3] and North Jakarta, Indonesia [4], catchment areas comprising both middle class and slum neighborhoods were selected, and surveillance for diarrhoea established in public and private outpatient clinics and hospitals serving the catchment population. In Indonesia, a population of 160,257 living in two North Jakarta districts, Tanjung Priok and Koja, was under surveillance [4]. The study included residents who presented with diarrhoea to two hospitals and eight health centres (including private facilities) [5]. In India, 62,329 individuals residing in three areas in the city of Kolkata were under surveillance for diarrhoea [3]. Five project health outposts were set-up in the neighborhoods and two at the city's infectious disease and children's hospitals (public COI data were collected at only one hospital[6]).

The annualized incidence rates ranged from 0.45 cases per 1000 population per year in North Jakarta to 4.0 cases per 1000 population per year in Mozambique. (Table 1) The incidence in children under 15 years of age was higher than the incidence in persons 15 years of age and older.

Measuring the patient costs of cholera

To collect data on patient costs of illness due to culture-confirmed cases of cholera, two interviews were conducted at the patient's home – at 7 and 14 days after the laboratory confirmation of cholera. Patient costs include the out-of-pocket costs borne by the patient including payments for medical care, drugs, transportation cost, and imputed expenses, such as lost work time (Table 2). For adult cases, the patient was interviewed. For cases in children, an adult familiar with both the episode and the household finances was interviewed.

Standard questionnaires were developed to ensure that similar data were collected in each study site. Local collaborators translated the questionnaires and tailored the questions and the responses to local circumstances (e.g., used the local phrases for different types of health care facilities and providers).

The questionnaires measured direct costs and indirect costs. The direct costs were the sum of out-of-pocket expenses on medical and non-medical goods and services (Table 2). The indirect costs include the lost wages due to lost work time by the patients, their caregivers, and their substitutes, as well as estimates of the productivity losses due to forgone nonmarket activities including school, housework, and childcare. The estimated monetary value of nonmarket activities depends on the subject's age and the activity. Children's losses were monetized as in previous studies [6,7] because children are known to make important economic contributions to the household [8].

Measuring the public costs of cholera

Provider costs of treatment were measured at local health facilities using a micro-costing (bottom-up) methodology. First, data from public and private health facilities providing treatment were used to produce estimates of the cost of a day's hospitalization, the cost of a clinic visit, and the average cost of medicines and diagnostic tests. This information was combined with data from a sample of patients who were treated to estimate the provider's treatment cost per case of disease. Then, the portion of the total cost of treatment that was borne by the public sector was calculated as the provider cost of treatment minus the fees received from patients for their treatment. The fees received from patients were measured using the private COI data on direct costs paid to public health facilities for medicine, treatment, and laboratory tests.

Provider cost was drawn from facilities serving the disease burden study because they allowed for good access to facility records and they had data on culture-confirmed cholera infections, which minimized travel and logistical costs.

As described in Table 3, the public treatment cost studies in each country were not identical because of differences in the health care systems, availability of data, and the design of the DOMI projects in each country [5,9,10,11]. However, similar components were measured to maximize comparability of findings.

Total costs per episode of cholera

The total costs due to an episode of cholera were the sum of the patient cost and the public cost. To reflect the different costs structures, we obtained separate estimates of treatment costs for outpatient care and inpatient care.

Expected annual costs of cholera

The costs described above are *ex-post* estimates because they measure costs incurred by the patient and society after an individual contracted cholera. The annual expected cost of

cholera per person considers these estimates from the perspective of an individual or public health system that does not know whether an infection will occur. These *ex-ante* costs are the product of the estimated cost per episode and the annual incidence rate. For the two hospital-based studies, the *ex ante* costs measure the annual expected cost of a case of cholera severe enough to be hospitalized. These costs can be used to estimate the expected costs-of-illness avoided, which may be used to approximate the benefits of vaccination in a cost-benefit analysis of cholera vaccines [12].

Currency

All costs were measured in terms of local currency and converted to US dollars (USD) using the exchange rate at the midpoint of the cost-of-illness study. These values were adjusted for inflation using the US Bureau of Labor Statistics' consumer price index and expressed in terms of USD 2005.

These values are not directly comparable across countries because of differences in incomes and prices across countries. Using purchasing power parity (PPP) exchange rates obtained from the International Monetary Fund website, we have adjusted the *ex ante* cost estimates.

Ethical Review

The research protocols for both public and patient costs were approved by the relevant institutional, national, and local ethical review boards. After explaining the purpose of the study, voluntary verbal consent was obtained from each respondent in the patient COI study prior to the start of the interview.

III. Results

Ex post patient costs

Sample size and characteristics—In total, the patient costs were measured for 571 episodes of cholera, 291 in children and 279 in adults (Table 4). The hospitalization rates used for North Jakarta (22%) and Kolkata (38%) were taken from the disease burden study (Table 4), which is more accurate than similar data from the patient cost-of-illness study because the former relied on clinical treatment data while the latter relied on self-reports. All patients were treated as inpatients in the hospital-based studies in Matlab and Beira.

The average duration of illness ranged from 3 to 8 days (Table 4). On average, children missed less than one day of school due to cholera in Matlab, North Jakarta and Kolkata and children in Beira missed 3 days of school. Adult patients missed an average of 1 to 4 days of work. Less than a quarter of all cases used substitute labor, but the majority of cases involved caregiving.

Respondents were asked about all treatment sought before and after diagnosis. In Matlab and Jakarta, most cases (78% and 53%, respectively) received some treatment at home. In Kolkata, visits to public (43%) and private (26%) health facilities accounted for the majority of treatment visits. In Beira, all patients sought treatment at the CTC.

The public treatment cost estimates rely on data from 510 episodes of illness (Table 4).

Direct and indirect patient costs—When considering all cases, regardless of age, the indirect patient costs exceeded the direct patient costs in all sites except Jakarta (Table 5). In Jakarta, where direct costs of treatment were very high, direct patient costs were many times indirect patient costs for adults (Table 6), where lost work time imposes costs on the household. Direct costs exceed indirect costs for children's cases in most cases (Table 7),

because indirect costs tend to be lower due to patients' having lower economic productivity. The largest components of indirect costs were the patient's and caregivers' lost productivity. Treatment costs were the largest component of direct patient costs at all sites, followed by the costs of transportation, and the costs of meals and lodging for persons accompanying the patient to treatment.

Sources of payment

Jakarta is the only site where direct costs were paid by households in the majority (88%) of cases. In Matlab, Kolkata, and Beira, costs were paid by a combination of facilities and patients in 99%, 100%, and 96% of cases, respectively. The percent of households that borrowed money to pay for treatment ranged from 12% in Jakarta to 28% in Beira (Table 4).

Provider and public treatment costs—Average provider treatment costs for inpatient cases (among children and adults) ranged from about USD 20 to 30 in Matlab, Kolkata, and Beira (Table 8) and were much higher in North Jakarta (USD 126 for children; USD 164 for adults). The provider costs for outpatient cases in Jakarta were USD 14 for adults and USD 26 for children.

Patient cost study respondents' payments to public facilities ranged from USD 1 to 4 for hospitalized cases in Matlab, Kolkata, and Beira. In North Jakarta, the patient payments to public facilities were USD 87 for hospitalized cases in children and USD 62 for hospitalized cases in adults. Patient payments for public outpatient treatment was USD 0.3 for children in Kolkata, USD 3.3 for children in N. Jakarta, and USD 8 for adults in N. Jakarta.

The average public treatment costs (provider treatment costs minus patients' payments) for hospitalized cases were about USD 15 to 40 for children; USD 18 to 30 for adults in Matlab, Kolkata, and Beira; and USD 101 for adults in Jakarta. The public treatment costs of outpatient cases were only measured in Jakarta where they were USD 22 for children and USD 6 for adults.

The public costs of inpatient treatment were greater for adults than for children in Matlab, Kolkata, and Beira, while the opposite was true in North Jakarta.

Total (ex post) costs per episode of cholera—For all ages combined, the average total cost of a hospitalized episode of cholera was USD 32 in Matlab, USD 35 in Kolkata, USD 47 in Beira, and USD 206 in N. Jakarta (Table 5), and the costs were higher for adults (Table 6) than children (Table 7) in all sites except Beira (where the costs were the same). The average total cost of an outpatient case is only available in North Jakarta, where these costs (USD 28) are much lower than the average total cost of a hospitalized case. In North Jakarta, the outpatient costs were higher for children (USD34) than adults (USD 24).

Ex ante COI—The annual expected costs of hospitalized cases were USD 0.06 (PPP 0.27) in Kolkata, USD 0.07 in Matlab (PPP 0.35), and USD 0.19 (PPP 0.87) in Beira. The relatively higher *ex ante* costs in Beira reflect the high incidence rates in that site. The expected costs of cholera in North Jakarta, including the costs of mild and severe cases, were USD 0.06 (PPP 0.19) for children and USD 0.02 (PPP 0.05) for adults.

IV. Discussion

In order to conduct economic analyses of cholera immunization programmes, there is a need for estimates of the costs that cholera imposes on society. The comprehensive cost estimates reported in this paper relied on a single research protocol to ensure comparability and are the most detailed and robust estimates of the costs of illness of cholera available. The studies

tracked culture-confirmed cases for up to 14 days across a range of epidemiological and health care settings and represent a significant contribution to what is known about the costs of illness due to cholera in developing countries. Previous studies of the costs of cholera [13, 14, 15] have not quantified the patient costs or the costs of cholera in endemic (rather than epidemic) settings, while previous studies of the costs of unspecified diarrhoeal disease [16,17] lacked the specificity needed to assess disease-specific interventions. This study contributes to the thin literature on community-based studies of the cost of illness due to diarrheal disease [18, 19, 20]. Hospital-based studies in Matlab and Beira found that the costs of severe cholera were USD 32 and 47, respectively, and the majority of costs are borne by the public health care system. Community-based studies in North Jakarta and Kolkata measured the costs of both severe (hospitalized; USD 206 and 35, respectively) and less severe cholera. North Jakarta is the only site in which the public costs were less than patient costs, due to large private payments to public facilities. The costs of cholera were highest in North Jakarta (USD 206 for a hospitalized case; USD 28 for a non-hospitalized case) due to higher fees relative to other sites and the study's inclusion of private treatment facilities.

Patient costs of illness as a percentage of average monthly income were 21% and 4% for hospitalized and non-hospitalized cases (respectively) in Kolkata (average monthly income= USD 84) and 65% and 7% for hospitalized and non-hospitalized cases (respectively) in North Jakarta (average monthly income = USD 207). Patient costs in this range have been found to be catastrophic for poor households that have poor health [21,22]. Further, limited socioeconomic data available for patients in Kolkata indicates that households with cholera patients tended to be more disadvantaged than households without cholera. This burden on families is not captured by studies that adopt a provider perspective (e.g., the WHO-CHOICE methodology).

In most cases, the costs were greater for adult patients than child patients, which reflected the fact that child patients had lower income and productivity losses than adults.

Our cost estimates may underestimate true costs of illness for several reasons. Respondents in North Jakarta and Kolkata indicated that 20 to 25% of families sought private treatment at some point during the illness. If private treatment was under-represented in these studies (since most study facilities were public), then the private COI will understate the cost to individuals in the general population who would have had no option but to seek, and pay for, private care in the absence of the DOMI presence. Also, the cost estimates do not include any of the interest payments or transaction costs that were incurred by the 13% to 27% of families who borrowed money, nor do they measure the costs borne by employers and insurers. Other reasons for a discrepancy between our estimates of public cost and true public costs include the fact that data quality available at public sector health facilities in developing countries are generally poor and assumptions about how public health expenditures are allocated across services was required.

The study design may have distorted costs somewhat by offering a high standard of care that was not representative of existing health care. Also, since the public cost study relied on only one or at most a few facilities in the study areas, these costs may not be representative of the overall public health care provision system in the study country. Futher, information campaigns in North Jakarta and Kolkata, which informed the study population about symptoms that should be treated and where to seek care, and the ongoing ICDDR,B disease surveillance may have sensitized the public and encouraged early treatment of cases. If so, this may have reduced the incidence of severe illness and more expensive cases.

Finally, using total cost savings as a measure of the benefits of disease prevention understates the economic impact because it does not include the benefits of preventing premature death, the discomfort of pain and suffering, and any expenditures made by households, communities and governments to prevent disease (e.g., drinking water treatment, information campaigns). The DOMI programme's willingness-to-pay studies have generated more comprehensive measures of benefits for cholera [23, 24, 25, 26] and typhoid fever [27, 28].

Since sample sizes vary considerably across sites, the cross-site comparisons are limited by the varying precision of the estimates. Also, variation in household characteristics within and across sites, and variation in the health care system and quality may help explain differences in costs across sites. However, there is very little information on the socioeconomic characteristics of the households to perform these analyses.

These data are likely to yield more accurate estimates of avoided costs of illness for use as measures of economic benefits in the preparation of investment cases for interventions that prevent cholera.

Acknowledgments

This work was supported by the Diseases of the Most Impoverished Program, funded by the Bill and Melinda Gates Foundation and coordinated by the International Vaccine Institute.

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Table 1

Disease Burden by Study Site[†,*]

Site	Matlab, Bangladesh ‡	North Jakarta, Indonesia	Kolkata, India	Beira, Mozambique
Disease Surveillance Period	1994-2003	Aug., 2001–July, 2003	May, 2003–April, 2005	Jan.-Dec. 2004
Surveillance target (years)	All ages	All ages	All ages	2 years old and above
Cholera Incidence by age group (per 1000 per year) [N. of Cases]				
1-4 years old	2.88	0.90	3.55	4.27
15+ years	1.03	0.27	0.93	3.85
Total	2.09	0.45	1.64	4.00

[*] The annual incidence of culture-confirmed cholera was calculated using the population as the denominator and the number of cholera cases in the study area as the numerator.

[†] To compute the incidence rates for these two age groups, the incidence rates measured in the burden of disease studies are weighed by the proportion of the study site's population in each age group. In Matlab, the incidence rates measured by the burden of disease studies are weighted by the proportion of the total cases seen in each age group.

[‡] These average annual incidence rates are based on 10 years of disease surveillance (from 1994-2003) conducted by ICDDR,B, including surveillance under the DOMI Programme from May 2004 to May 2005.

Table 2
Components of *ex post* private and public costs

Component	Patient Costs	Public Costs
Direct Costs	Treatment—including: diagnostic tests medicine examination bed charges ** Transportation Nonmedical items—including foods and beverages used to aid treatment Lodging and meals for other persons * Other payments	Publicly borne costs of: an outpatient visit in a public clinic a day of hospitalization in a public hospital the medicines received by the patient in the treatment of the disease the diagnostic tests used for patients with the disease.
Indirect Costs †	Patient's lost income/production ‡ Substitute laborers' net lost income/production *** Caretakers' lost income/production Other persons' lost income/production	n.a.

* These were most often persons who accompanied the patient when they sought treatment

** If there is an overnight stay

*** A substitute is someone who did the patient's or caregiver's work for them while they were either sick or giving care. This is "net" because substitute laborers result in a net increase or decrease in lost productivity. On the one hand, they can increase losses if they are not able to perform their own work. On the other hand, they reduce losses when they replace patients lost labor. This item is equal to (substitute laborers' own lost income/production) + (substitute laborers' contributions to income/production by doing patients' work).

† The value of daily productivity was the product of an assumed age-specific wage and an occupation-specific wage. The assumed age specific wages for adults, teenagers, and children were the patient's daily wage, one-half the average patient daily wage, and one-quarter of the average patient daily wage, respectively. The occupation specific wages for working on a farm, working at home, going to school, and leisure were 70%, 50%, 50%, and 30% of the assumed age specific wage, respectively. If the patient did not report their daily wage, it was replaced with the sample average.

‡ These productivity losses also reflect time spent waiting and traveling to receive health care.

Table 3
Summary of Recruitment Procedures and Project Care for Facility-Based Studies

Study site	DOMI project care
Matlab, Bangladesh	DOMI patients were identified among the diarrhoea patients of Matlab Health and Demographic Surveillance System of ICDDR, B that were confirmed, admitted, and treated at ICDDR,B's Matlab hospital. Laboratory confirmation was done in ICDDR, B Matlab hospital for all patients followed by full range of treatment including antibiotic, intravenous fluid and ORS therapy. This is atypical treatment since the hospital does not typically do lab tests and often faces shortages of medicine and other supplies.
North Jakarta, Indonesia	DOMI patients were identified among the diarrhoea patients that presented and were treated in the public health facilities serving the study area. With the exception of additional diagnostic procedures to confirm cases. DOMI patients receive care in the same environment as the general population.
Kolkata, India	DOMI patients were identified in screening clinics specifically set up for the project. Patients were then directed to private health care providers and reimbursed for treatment expense. A few cases were hospitalized in the two public hospitals serving the study area. Though there is a public health care service provision system, many of people in disadvantaged urban areas rely on private health care (estimated by local team at 30%).
Beira, Mozambique	DOMI patients were identified among those treated at the Cholera Treatment Center (CTC) in Beira. The CTC is a specialized facility treating only diarrhoeal disease and open only during the six months of the rainy season. There were additional diagnostics performed for the DOMI patients that are not routinely performed at the CTC.

Table 4

Patient Cost Sample Characteristics, by Study Site

		Matlab, Bangladesh	N. Jakarta, Indonesia	Kolkata, India	Beira, Mozambique
Number of Cases in the Patient Cost Sample		278	176	66	50
	Child (<18 years old) Cases	*151*	*82*	*39*	*19*
	Adults Cases	*127*	*94*	*27*	*31*
Number of Cases in the Public Cost Sample					
	Child (<18 years old) Cases	*168*	*30*	*45*	*19*
	Adults Cases	*136*	*24*	*57*	*31*
Hospitalization Rate *	*Child (<18 years old) Cases*	99.3%	23.5%	29.7%	100.0%
	Adult Cases	100.0%	19.0%	50.7%	100.0%
	All Cases	99.6%	21.7%	37.7%	100.0
Average daily wage rate in USD		2.1 (2.0)	4.5 (3.0)	1.4 (0.8)	1.7 (1.3)
	Percent of sample reporting	12%	24%	59%	37%
Average Number of Days Ill (SD)	*Child (<18 years old) Cases*	3.6 (2.4)	7.3 (5.4)	6.6 (3.6)	5.8 (1.9)
	Adult Cases	3.2 (1.8)	4.7 (3.7)	5.9 (3.0)	7.5 (4.5)
Average Number of Missed School Days (SD)		0 (0)	0.4 (1.9)	0.7 (1.6)	2.8 (1.2)
Average Number of Lost Work Days (SD)	*Patients*	1.7 (2.5)	1.1 (2.0)	2.1 (2.6)	3.7 (2.7)
	Substitutes	0.5 (1.6)	0.0 (0.4)	0.0 (0.0)	0 (0.0)
	Caretakers	2.8 (2.4)	1.2 (2.6)	0.2 (0.9)	5.2 (6.5)
	Companions	0.6 (1.5)	0.7 (1.6)	0.3 (1.2)	
Percent of child patients who missed school		0%	15%	33%	100%
Percent of patients with substitute labor		24%	15%	0%	22%
Percent of patients with care givers		100%	84%	70%	96%
Percent of families that borrowed money to pay for treatment		13%	14%	20%	27%

* These hospitalization rates reflect the percentage of cases in the surveillance study that were treated in an inpatient setting.

Table 5

Cost of Illness per Episode of Cholera by Treatment Setting and Study Site, All Patients (2005 USD) [a]

	Study Site			
	Matlab	**N. Jakarta** [b]	**Kolkata**	**Beira** [c]
Sample Size	(n=277)	(n=176)	(n=66)	(n=49)
Hospitalized cases	(n=277)	(n=36)	(n=28)	(n=49)
Patient costs	12.4	134.0	17.9	18.8
Direct costs	5.2	112.1	6.8	4.6
Indirect costs	7.2	21.8	11.0	14.1
Public costs	19.1	71.7	17.6	28.4
Total costs	**31.5**	**205.7**	**35.4**	**47.2**
Outpatient cases:		(n=140)	(n=38)	
Patient costs		14.5	3.7	
Direct costs		8.4	1.0	
Indirect costs		6.0	2.7	
Public costs		13.6	n.a.	
Total costs		**28.1**	**n.a.**‡	
Hospitalization rate for adult cases†	100.0%	21.7%	37.7%	100.0%

†The hospitalization rates in this table are from the DOMI Burden of Disease Studies.

‡These estimates are not available (n.a.) due to incomplete information on the public costs of outpatient treatment.

[a]Outpatient costs are not available from the Matlab and Beira study sites because these were hospital-based studies.

[b]In Jakarta the public treatment cost were $144 for inpatient treatment, $44 for outpatient treatment in a hospital, and $2 for outpatient treatment in a health centre (Stewart 2005). The cholera cases in public cost study cannot be matched to the cholera cases in the patient cost study. Information from the patient cost study on the health care facilities where patients sought treatment is used to determine which public treatment cost estimate applies to each case. After adjusting for inflation to 2005 USD and subtracting private payments to public facilities from the public treatment cost, the public treatment costs for inpatients and outpatients are $71.7 and $13.6, respectively.

[c]In Beira, a slight difference between net public COI ($28) and the public COI ($30) is due to inflation adjustment and subtraction of private payments to public facilities.

Table 6

Adult Cost of Illness per Episode of Cholera by Treatment Setting and Study Site (2005 USD) [a]

	Study Site			
	Matlab	**N. Jakarta [c]**	**Kolkata**	**Beira [e]**
Sample Size	(n=127) [b]	(n=94)	(n=27) [d]	(n=31)
Hospitalized cases	(n=127)	(n=19)	(n=14)	(n=31)
Patient costs	17.7	121.6	28.6	17.1
Direct cost	6.5	100.7	7.5	5.0
Indirect costs	11.2	20.9	21.0	12.1
Public costs	18.2	101.4	20.0	29.9
Total costs	**36.0**	**223.0**	**48.6**	**47.0**
Outpatient cases:		(n=75)	(n=13)	
Patient costs		17.2	5.9	
Direct costs		10.0	0.6	
Indirect cost		7.2	5.3	
Public costs		6.3	n.a.	
Total costs		**23.5**	**n.a.‡**	
Hospitalization rate for adult cases†	100.0%	19.0%	50.7%	100.0%

†The hospitalization rates in this table are from the DOMI Burden of Disease Studies.

‡These totals are not available (n.a.) due to incomplete information on the public costs of outpatient treatment.

[a]Outpatient costs are not available from the Matlab and Beira study sites because these were hospital-based studies.

[b]For adults, all private COI cases (127 cases) are matched with public COI cases (136 cases).

[c]In Jakarta the public treatment cost were $144 for inpatient treatment, $44 for outpatient treatment in a hospital, and $2 for outpatient treatment in a health centre (Stewart 2005). The cholera cases in public cost study cannot be matched to the cholera cases in the patient cost study. Information from the patient cost study on the health care facilities where patients sought treatment is used to determine which public treatment cost estimate applies to each case. After adjusting for inflation to 2005 USD and subtracting private payments to public facilities from the public treatment cost, the public treatment costs for inpatients and outpatients are $71.7 and $13.6, respectively.

[d]For adults in Kolkata, only 11 out of 27 cases of cholera from the patient cost study are matched to cholera cases from the public cost studies (n=57). Among the unmatched cases, three cases were treated in an inpatient setting and thirteen were treated as outpatients, based on information from patient cost study. For the three inpatients, the average value of public COI is $18.8. The public treatment costs for the 13 outpatients are not available.

[e]In Beira, all cases of cholera from the patient cost study are matched to cases of cholera in the public cost study.

Table 7

Child Cost of Illness per Episode of Cholera by Treatment Setting and Study Site (2005 USD)[a]

	Study Site			
	Matlab	**N. Jakarta** [c]	**Kolkata**	**Beira** [e]
Sample Size	(n=150) [b]	(n=82)	(n=39) [d]	(n=18)
Hospitalized cases	(n=150)	(n=17)	(n=14)	(n=18)
Patient costs	7.9	147.8	7.2	21.6
Direct costs	4.0	124.9	6.2	3.9
Indirect costs	3.9	22.9	1.0	17.7
Public costs	19.8	38.6	15.1	26.0
Total costs	**27.8**	**186.4**	**22.3**	**47.6**
Outpatient cases:		(n=65)	(n=25)	
Patient costs		11.3	2.6	
Direct costs		6.6	1.2	
Indirect costs		4.7	1.4	
Public costs		22.1	n.a.	
Total costs		**33.5**	**n.a.**‡	
Hospitalization rate for adult cases†	100.0%	23.5%	29.7%	100.0%

†The hospitalization rates in this table are from the DOMI Burden of Disease Studies.

‡These totals are not available (n.a.) due to incomplete information on the public costs of outpatient treatment.

[a]Outpatient costs are not available from the Matlab and Beira study sites because these were hospital-based studies.

[b]All private COI cases are matched with public COI cases.

[c]In Jakarta the public treatment cost were $144 for inpatient treatment, $44 for outpatient treatment in a hospital, and $2 for outpatient treatment in a health centre (Stewart 2005). The cholera cases in public cost study cannot be matched to the cholera cases in the patient cost study. Information from the patient cost study on the health care facilities where patients sought treatment is used to determine which public treatment cost estimate applies to each case. After adjusting for inflation to 2005 USD and subtracting private payments to public facilities from the public treatment cost, the public treatment costs for inpatients and outpatients are $71.7 and $13.6, respectively.

[d]For children in Kolkata, only 10 private COI cases (out of 39) are matched with cholera cases from the public cost study (n= 45). Among the unmatched cases, 4 cases are inpatients and 25 are outpatients based on information from patient cost data. For the four inpatients, the average value of public COI ($19.9) is imputed. The public treatment costs of 25 outpatients are not available.

[e]In Beira, most cases of cholera from the patient cost study are matched to cases of cholera in the public cost study.

Table 8

Provider Costs per Case, Private Expenditures to Public Facilities, and Public Treatment Costs per Case (2005 USD) [a]

Age Group	Treatment Setting		Matlab	N. Jakarta	Kolkata	Beira
Children	Hospitalized	Provider treatment costs	20.8	126.0	18.2	27.4
		Private payments to public facilities	0.9	87.4	3.1	1.5
		Public treatment costs	19.8	38.6	15.1	26.0
	Outpatient	Provider treatment costs		25.5	n.a	
		Private payments to public facilities		3.3	0.4	
		Public treatment costs		22.1	n.a.	
	Hospitalization rate[†]		*100.0%*	*23.5%*	*29.7%*	*100.0%*
Adults	Hospitalized	Provider treatment costs	19.3	163.7	23.7 [e]	31.4
		Private payments to public facilities	1.1	62.3	3.7	1.6
		Public treatment costs	18.2	101.4	20.0	29.9
	Outpatient	Provider treatment costs		14.3	n.a.	
		Private payments to public facilities		8.1	0.0	
		Public treatment costs		6.3	n.a.	
	Hospitalization rate[†]		*100%*	*19.0%*	*50.7%*	*100.0%*
All Ages	Hospitalized	Provider treatment costs	20.1	145.9	21.0	30.0
		Private payments to public facilities	1.0	74.2	3.4	1.5
		Public treatment costs	19.1	71.7	17.6	28.4
	Outpatient	Provider treatment costs		19.5	n.a.	
		Private payments to public facilities		5.9	0.3	
		Public treatment costs		13.6	n.a.	
	Hospitalization rate (%)[†]		*100.0%*	*21.7%*	*37.7%*	*100.0%*

[†]The hospitalization rates in this table are from the DOMI Burden of Disease Studies.

[a]Outpatient costs are not available from the Matlab and Beira study sites because these were hospital-based studies.